IN THE UNITED STATES DISTRICT COURT

FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex rel, W.A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA, et al.	)	
Plaintiffs,	)	
V.	)	No. 05-CV-329-GKF-SAJ
TYSON FOODS, INC., et al.,	)	
Defendants.	)	

REPORTER'S TRANSCRIPT OF PROCEEDINGS

FEBRUARY 19, 2008

PRELIMINARY INJUNCTION HEARING

VOLUME I

BEFORE THE HONORABLE GREGORY K. FRIZZELL, Judge

APPEARANCES:

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UNITED STATES COURT REPORTER

information, we still don't have it. How much have you charged to date, sir?

A. I believe the number is about $400,000 over three and a half years.

Q. In your lines of evidence, you talked about doing a review of technical literature?

A. Yes, sir.

Q. Which led you to the conclusion that there's a high concentration of E. coli, Salmonella and Campylobacter in poultry waste?

A. In poultry operations and poultry waste.

Q. In poultry operations and in poultry waste. Well, we know, for example, that one of the reasons that we want to thoroughly cook chicken is because of the possibility of Salmonella; right?

A. Yes, sir.

Q. Chicken can either come to your kitchen with the Salmonella or it can acquire it when it's in your kitchen out on the countertop; is that right?

A. I suppose that it can. I don't believe that's the most likely situation.

Q. Every warm-blooded mammal is a reservoir of E. coli; is that right?

A. I would say that's true, yes, sir.

Q. Each one of us here -- all but one of us here in this

work that we do.

Q. Well, let's back up because maybe I misunderstood.

MR. BULLOCK: Judge, we're well past the half hour, I just wonder when counsel is going to wrap up. I'm not trying to hold people to specific --

MR. GEORGE: Two minutes, Your Honor.

THE COURT: Very good.

Q. (By Mr. George) I want to make sure I understand, Dr. Teaf. You're not offering an opinion in this case regarding the likelihood of transport of poultry litter to a water body compared to other sources; is that correct?

A. No, I'm not. No, I'm not. I'm identifying sources, and I'm identifying receptors.

Q. In fact, yesterday when you talked about -- I think you threw out some percentages in terms of cattle manure versus poultry litter. You were talking just about your analysis of how much hits the ground, not how much gets to the water; correct?

A. And subsequent to that I discussed the importance of knowing how it may make its way to the water body, yes, sir.

Q. But you're not offering an opinion as to whether it got there or not because you're not offering a fate and transport opinion; correct?

A. Well, I am offering an opinion about that it got there and I'm offering it for two reasons. One, the bacteria levels are

very high and second of all, the signature that was identified is of cattle -- is of poultry.

Q. You're relying upon the work of Dr. Roger Olsen for your belief that the water shows the evidence of poultry contamination; correct?

A. In part I am and I'm also relying upon that of Dr. Harwood and the other lines of evidence that I described yesterday.

Q. But you yourself, sir, have conducted no fate and transport analysis; correct?

A. No, I did not, not a formal one, no.

Q. Sir, based upon the work that you've done in this case, not the work of others, can you state to a reasonable degree of scientific certainty that if Judge Frizzell grants the injunction that is requested by your client, the water quality standards for bacteria in the Illinois River will be met in 2008 and 2009?

A. My opinion is that they will be.

Q. Can you state that opinion to a reasonable degree of scientific certainty?

A. I can based on the information that I have reviewed.

Q. You're willing to stake your professional reputation on the proposition that if this Court enters the injunction sought by your client, the water quality standards for bacteria in the Illinois River will be met next year?

A. Based on all the information that I have and my knowledge

A. Yes, there is. And the reason that I just didn't recall at the time -- the Wise County cases involved bacterial growth producing hydrogen sulfide in residential wells as a consequence of the introduction of natural gas and condensate. So I didn't think about them as coming from the surface, but the contaminant of concern was hydrogen sulfide is microbially produced.

Q. Sir, you were not asked to evaluate in that case the fate and transport of bacteria found in groundwater, were you?

A. No.

Q. You were simply evaluating the effects of groundwater -- I'm sorry, of bacteria found in certain wells?

A. That's correct.

Q. So as it stands today, sir, you have never before worked on a litigated matter in which you were asked to offer an opinion as to the fate and transport of bacteria to groundwater?

A. That's correct.

Q. Sir, prior to being retained by the Plaintiffs' lawyers representing the attorney general's office in this case, had you ever worked on a research project or published a paper related to the movement of bacteria in either surface water or groundwater?

A. No.

Q. Sir, have you ever had your opinions in an environmental

Q. And elsewhere?
A. Yes. And Salmonella was identified in edge of field samples and enumerated.
Q. Really?
A. Yes.
Q. You don't agree that the State took 68 samples for soil and found none with Salmonella in them?
A. No, I wasn't talking about soil. I was talking about edge of field. But soil, that could well be. I don't disagree.
Q. So what the State did find was fecal indicator bacteria, that's right?
A. The State did find fecal indicator bacteria, yes.
Q. Let's bring up Defendants' Demonstrative 33, if we can. I think this might help lay out what we've been talking about. I think it's 32. I'm sorry to have used the wrong number, it's 32. Okay. So you talked about fate and transport, you did not do a fate and transport analysis in this case?
A. Correct.
Q. Okay. So let's talk about what fate and transport is. What do you see on your screen there?
A. Well, can I restate that for a second or can I please restate my answer?
Q. Sure.
A. We didn't do a specific fate and transport analysis, but we did construct our sampling regime so as to be able to assess

Q. -- than if they were spread out on a field?
A. Correct.
Q. And if you were to spread out bacteria on the field in a thin, fine dust and thereby expose them to sunlight, those would die within a few hours?
A. Well, that depends on what you mean by a thin, fine dust.
Q. Thin enough that they could see the sunlight, they could be exposed to the sunlight?
A. If they are directly exposed, then they -- we're going to have a pretty high inactivation rate as long as they don't make it into the soil. If they do make it into the soil, then they'll be protected.
Q. And in talking about those same factors, dryness kills bacteria. I believe you used the word desiccation by that, but you mean dryness; right?
A. Correct.
Q. And that kills bacteria?
A. Correct.
Q. So the same thing, a cow pie shelters bacteria by keeping in the moisture; is that right?
A. Compared to?
Q. Compared to a thin dust?
A. Yeah, compared to a thin dust.
Q. Now, you're not offering an opinion in this case as to the relative rates of movement of bacteria that you've studied and

testified about; is that right?
A. Not to the relative rates of movement, no.
Q. In fact, as part of your work in this case, you did not study the movement characteristics of any type of bacteria in the watershed, did you?
A. No, I did not.
Q. Nor are you offering any opinion today about the different survival rates of the different bacteria in the Illinois River Watershed?
A. Can you rephrase that, sorry.
Q. Are you offering any opinion today as to the relative survival rates of the bacteria that you found in the watershed?
A. No.
Q. And you didn't study under what conditions and how long bacteria survived in this watershed, did you?
A. No, but we have done extensive studies of that in my lab.
Q. But you didn't study it here in the watershed?
A. Not in the watershed, no.
Q. Now, let's focus on the barn there on the screen. I've got that up as a representative of a poultry house. You don't know very much about the survivability of bacteria in poultry litter lying on a poultry house floor, do you?
A. I know that they're in a relatively stressful situation in that environment but I think you said relative survivability?
Q. Right.

A. Meaning with respect to one another?
Q. To each other, to one another.
A. We know that Enterococci tend to survive better than E. coli in poultry litter. That's one thing that's fairly well-established in the literature.
Q. And you know that poultry litter in houses is often layered, multiple layers go in?
A. Yes.
Q. And it sits there for a while?
A. Yes.
Q. Do you have an opinion whether the time that passes and the layering kills off the bacteria?
A. I would -- my opinion would be that -- which I haven't tested as we've established, but my opinion would be that the bacteria on the top layer of litter -- there are probably more viable and culturable bacteria on the top layer of the litter than there are at lower layers.
Q. And the ones at the lower layers would be dead or dying?
A. Well, they would be stressed at least.
Q. So you didn't study how long bacteria can survive laying out in a field after they were removed from a poultry house, did you?
A. Not specifically.
Q. You didn't study the specific fate and transport characteristics of bacteria moving between fields in the

watershed, did you?
A. No, I did not.
Q. And you didn't study the bacterial survival characteristics in the streams in the IRW?
A. Not specifically in the streams. Although again, we've done a lot of work in my labs, so I have a strong basis for opinions about that.
Q. You're not offering an opinion in this case as to the relative bacterial survival characteristics in the streams, are you?
A. You'd have to be a little bit more specific in your question.
Q. Did you study bacterial survival characteristics in the streams in the Illinois River Watershed?
A. Not in terms of an experimental study, no.
Q. All right. Let's walk through this demonstrative. So in a traditional fate and transport, you start in the poultry house, you move to the field where the litter is applied. And then you have to track how the litter moves, if at all, how bacteria in the litter move, if at all, as they encounter an edge of a field; is that right?
A. Well, there's all sorts of ways that you can design a study like that.
Q. Is that one way --
A. It depends on your questions.

Q. Is that one way to design it?
A. That is one way to design it.
Q. Then at the edge of a field you might encounter another field; is that right?
A. The edge of a field would be the edge, there would be something there to stop it.
Q. There would be something there to stop the bacteria from moving off the edge of the field?
A. No, there would be -- an edge of a field means an edge. There's something else there, a road, a ditch, something.
Q. Or another field?
A. I'd call that the same field.
Q. Okay. So it's your testimony that in the Illinois River Watershed all fields end in either a road or a ditch?
A. My concept of the term -- I'm sorry. Can I explain just briefly? My concept of what an edge of field is, is it's the end of a large, grassy expanse that would make up a field and then there would be something that would interrupt that grassy expanse, whether it be a ditch or a ditch and a road or a structure or something.
Q. And did you observe the sampling in this case?
A. No, I did not.
Q. So do you know if at the edge of the field, there was simply another field or always a ditch or a road?
A. In the edge of field samples that were collected in this

case, there was some sort of a ditch or a depression in which water could collect because those were water samples, the edge of field samples.

Q. So there were never -- if other witnesses have testified that there were puddles at the edge of a field, you contradict them?

A. No, I said a depression or a ditch or something where they could collect the water.

Q. In fact, you don't know what was at the edge of the field; isn't that right?

A. From what I've been informed, it's usually a ditch.

Q. In cases where it's a ditch or not a ditch, if there's another field beyond it, let's move through that, and then let's move through the demonstrative, and eventually then you reach the stream. If the question you are trying to address in a traditional fate and transport, and this is what I'm trying to bring out, that the bacteria in the stream came from the poultry house, don't you have to track it across the environment?

A. To demonstrate what?

Q. If you are trying to show --

MR. JORGENSEN: Your Honor, may I approach the demonstrative? It might help. We're having some trouble, maybe I can cut it short.

THE COURT: Yes.

Q. (By Mr. Jorgensen) Was the question that you were trying to address in this case, Dr. Harwood, whether bacteria that are found in the streams, whether those came from poultry litter? Is that the question you were trying to address?

A. Not directly whether bacteria that came from one particular field were in one particular stream, but whether there was a gradient of these signals from one compartment, in other words, from one type of sampling entity to another.

Q. So the bacteria that you find in a stream, E. coli, let's take that for example, they could come from cattle; right?

A. In certain streams there would be some possibility for contamination from cattle.

Q. They could come from birds?

A. There could be a bird component.

Q. If you found Salmonella, it could come from reptiles?

A. Salmonella has been isolated from reptiles.

Q. So if you found Salmonella in the streams of the Illinois River Watershed, it could come from reptiles? I'm not trying to trick you with these questions. I'm actually trying to clarify what you did.

A. So if I found Salmonella at an edge of the field sample I would --

Q. If you found Salmonella in the streams of the Illinois River Watershed, they could come from reptiles?

A. They could come from other sources other than -- than that

field, yes.
Q. And it was your job to help the plaintiffs understand whether the bacteria that you found in water, groundwater or streams, whether it came from poultry litter?
A. It was my job to determine whether or not there's a correlation between the practices of land applying this poultry litter and the contamination that's appearing in streams, that's how I would phrase it.
Q. And you did not do that through a traditional fate and transport analysis, you did it through the microbial source tracking we were just talking about?
A. We did the microbial source tracking, yes, as a way of determining whether or not we had a specific poultry litter signature in that water.
Q. All right. Now, let's talk for just a moment about the animals that live in the Illinois River Watershed. Pigs carry Campylobacter; is that true?
A. Pigs are not well-known to carry Campylobacter. I'm sure there's been a couple of studies that have found them.
Q. And Salmonella also, don't pigs also carry Salmonella?
A. Yes, pigs carry Salmonella.
Q. Most reptiles, I think we established, carry Salmonella?
A. I wouldn't say most reptiles, but I know they've been isolated from some.
Q. Humans contribute fecal matter to the Illinois River

Watershed directly?
A. Hopefully not.
Q. You don't know whether they contribute it directly?
A. No, I don't know.
Q. Let's look at page 186, line 14 of your deposition. Page 186, lines 14 to 21.
(An excerpt of the videotaped deposition of Valerie Harwood was played.)
Q. "So humans can contribute fecal bacteria to waterways directly?
A. "Directly, yeah, and also through their waste disposal systems.
Q. "Okay. And are septic systems a potential source of fecal pathogen contamination?
A. "Septic systems can be if they're not properly constructed to be separated from the water table."
Q. (By Mr. Jorgensen) Dr. Harwood, you haven't studied how many species of animals live in the watershed, have you?
A. No.
Q. You don't know how many types of birds live in the watershed?
A. No.
Q. You haven't studied the migration patterns of birds through the watershed?
A. Not directly, no. I've had some information on it, but I

have not myself studied that.
Q. You did not quantify the volume of manure deposited by each different type of animal in the watershed, did you?
A. Not myself, no. Although I have seen information on the subject again and I know that annually in the Illinois River Watershed there's about 350,000 tons of poultry litter land applied. I know that from Chris Teaf's work, that the volume of, for example, poultry litter is one of the dominant sources of fecal material contributed.
Q. Let's look at page 72, 19 of your deposition, 72, 19 to 21.
(An excerpt of the videotaped deposition of Valerie Harwood was played.)
Q. "Did you attempt to quantify the type of manure from each type of animal in the watershed?
A. No, I did not."
MR. JORGENSEN: And Then let's go to page 121, line 25 to 122, 2 of your deposition.
(An excerpt of the videotaped deposition of Valerie Harwood was played.)
Q. "Do you know the per capita fecal production of any living animal in the IRW?
A. "No."
MR. JORGENSEN: And then let's go to page 72, line 25 to page 73, 3.

(An excerpt of the videotaped deposition of Valerie Harwood was played.)

Q. "Did you attempt to quantify the volume of bacteria that come from each type of animal in the watershed?

A. "No, I did not."

MR. PAGE: Your Honor, I object to that use of the deposition. Her testimony was not that she tried to do it, but that she reviewed other people's materials, and that deposition statement there did not contradict her statements.

THE COURT: The question on the record that Mr. Jorgensen asked, I thought had to do with an attempt to quantify the type of manure. Just one second.

MR. PAGE: I believe the question, if I heard it correctly was, did she attempt to quantify it.

THE COURT: You have not determined the volume of manure deposited by each type -- I can't make it out -- of the watershed.

MR. JORGENSEN: I'm actually reading from a little script. So it's, "You did not attempt to quantify the volume of manure deposited by each type of animal in the watershed, did you?" And then the direct response is 72, Lines 19 to 21.

THE COURT: Overruled.

Q. (By Mr. Jorgensen) Dr. Harwood, did you attempt to quantify the volume of bacteria deposited by pets in the watershed?

A. No.
Q. Did you attempt to quantify the volume of bacteria, I'm not talking about the manure, but the bacteria in the manure deposited by humans in the watershed?
A. No.
Q. And you don't know whether anyone else on the State's team did any of these things, do you?
A. There was -- material was reviewed as to the relative or the amounts of animal feces that would be deposited in or that could contribute to impairments in the watershed, but that material -- that research was not done by me.
Q. And you're talking about the amounts of feces, not the volume of bacteria in the feces?
A. Correct.
Q. You didn't study the effects of urban runoff on bacterial loading in the watershed, did you?
A. No.
Q. All right. We've covered the things that you did and that you didn't do. Let's move to the science of microbial source tracking generally. Now, microbial source tracking, it's a young science; is that right?
A. I would say it started in 1996 or so, depending on where you start, so, yeah, it's 20 years old.
Q. Would you agree that it's still developing?
A. Yes, much as all of microbiology is developing.

THE COURT: Rather than discuss it any further, let's take the next witness. And I'll just tell you how much time -- as you're running out of time, I'll tell you how much time we've got. And I'm going to start putting the stopwatch to it. Call your next witness.

MR. PAGE: Your Honor, the State calls Dr. Roger Olsen.

THE COURT: Dr. Olsen.

ROGER LEE OLSEN

Called as a witness on behalf of the plaintiffs, being first duly sworn, testified as follows:

THE COURT: State your name for the record, please.

THE WITNESS: Roger Lee Olsen.

THE COURT: Thank you, Mr. Page.

MR. PAGE: Thank you, Your Honor.

DIRECT EXAMINATION

BY MR. PAGE:

Q. Dr. Olsen, would you please summarize for the Court your education?

A. Yes, I have a bachelor of science degree in mineral engineering chemistry from the Colorado School of Mines in 1972, that's essentially a chemistry degree. Then I have my PhD in geochemistry in 1979 also from the Colorado School of Mines.

Q. Dr. Olsen, what work experience do you have that's related

to your opinions in this case?
A. Essentially after I got out of school, all my work since I graduated has been related to evaluating contamination in the environment.
Q. Okay. And what companies have you worked for?
A. When I first got out of -- while I was in graduate school, I actually was an instructor in chemistry and geochemistry for three years at the Colorado School of Mines. After I left the Colorado Schools of Mines, I was with Rockwell International for a year as a senior research chemist. And I went to a consulting engineering company called D'Appolonia Consulting Engineers that was bought out by International Technology. I was there six years. For the last 23 years I've been with Camp, Dresser, McKee or CDM.
Q. Now, as part of your work in the environmental field, has that involved designing sampling plans?
A. Yes, it has.
Q. How many sampling plans have you supervised the design for?
A. At least a hundred that I've been the major author or major contributor to.
Q. And would you explain to the Court the approach you follow when you design a sampling?
A. Yes, I've developed a systematic approach that I use that's kind of a step-wise approach. And the first approach is

addition, we brought in all the experts that we had to look at our sampling, too.

Q. And the experts for the particular area, for example, the stream expert would critique and evaluate the plan for sampling at the streams, for example?

A. Yeah, and the stream expert actually came in and said -- trained the people on how to do some specific things that he was the expert in doing and was there throughout the sampling, some of the sampling, to make sure it was being done right.

Q. I want to call your attention to Exhibit 375 which is before you on the counter. Can you identify that exhibit, please, sir?

A. That's just a brief description of some things about CDM and gives some examples of projects that we've done that are similar to these.

Q. Thank you, sir. Now, I want to change topics on you here. Was principal component analysis one method that was used to identify the source of contamination in the IRW?

A. Yes, it was one of those weight of evidence methods that I used.

Q. Okay. And again, remind us what is PCA?

A. PCA stands for principal component analysis. Again, in environmental sites that have a large number of contaminants, it's a statistical technique that allows us to determine the relationship of all those contaminants and the difference of

all those contaminants among each other.
Q. Now, Dr. Olsen, did you employ PCA to determine whether or not there was a unique poultry waste signature that could be identified in the waters of the Illinois River Watershed?
A. Yes, I did.
Q. And did you reach any conclusions with your evaluation?
A. Yes, I did.
Q. What are those conclusions?
A. First of all, I identified a unique combination of contaminants in the basin that was a poultry signature. And this signature was by far the most dominant signature in the basin and across all the samples.
Q. Did that combination of contaminants include both organic and inorganic constituents?
A. Yes, it does.
Q. And what constituents did it have from an organic basis?
A. Well, the organic part of that was, I guess you could call the bacteria organic or the total organic carbon we measured was organic. We measured all the metals. We measured all the nutrients. We measured some organic compounds called estrogens. We measured a variety of those. We measured general water quality chemistry, major anions, cations, TDS, TSS, things like that.
Q. So the poultry signature you're going to testify about includes both chemicals and bacteria?

normalized concentration so you don't weight everything too much. You take those two things, you multiply them together, the weight and the concentration. And then you do that for all 25 parameters and you add them all up and that's one number and that's called the score.

Q. And do you do this for all the samples that qualify for principal component analysis?

A. Yes, we did it for all the samples or at all the locations.

Q. Why do you do that?

A. That really tells us the differences in contamination sources between the different sites or the different samples.

Q. So does the higher the score versus the lower score tell you something with respect to that particular sample?

A. Yes, it really tells you how much it is impacted by that particular source.

Q. By a particular waste source?

A. Waste source, right.

Q. Okay. What did you do next, what was step number eight?

A. Step number eight. And before I talk about step number eight, step number one through seven is really just sampling chemicals and statistically evaluating the data. And that statistical evaluation of the data resulted in these two unique combinations of contaminants that we call principal components. Now, number eight is up to determine what those principal

components are, what sources they represent.
Q. So that's the next step?
A. Yes, it's to evaluate whether PC 1 and PC 2 are associated with a particular source.
Q. How did you go about doing that, sir?
A. Well, I did two types of analysis. I did what I call a spatial analysis and I did what I call a comparative analysis.
Q. Would you explain the spatial analysis, sir?
A. Well, for both principal components 1 and principal components 2 I created these what we call the scores.
Q. That's the one through ten score you mentioned on each sample?
A. Yeah. We normalized them, so they may go one to six or whatever but it's a numeric value that represents that principal component, the combination of all those chemicals. So looking at PC 1, I essentially ranked all those scores from very highest to very lowest and then I looked to see the order that we saw those scores. And very significantly, all the very high scores were edge of field samples and the very lowest scores were our unimpacted areas, first the ones outside the basin and then the ones inside the basin that had minimal impact. And then I looked at the range of scores in between the very highest and the very lowest and I found that it pretty well matches what you would expect as an environmental pathway. That is some of the high flow sampling stations had the next

is 30 to 50 times less. So -- and actually water samples, the difference in compositions is even more dramatic.

Q. What did you conclude based on the analysis of 457 and 459?

A. Again, that principal component 1 is related to and associated with poultry waste and not wastewater treatment plants.

Q. Did you perform a similar analysis for principal component number 2?

A. Yes, it turns out that those things that are higher in wastewater treatment plants than poultry waste are all those things at the bottom of the chart and confirm that wastewater treatment plant is associated with principal component 2.

Q. So to complete your step-wise analysis, how did you complete the work on principal component analysis?

A. Essentially it's outlined up there that identified principal component 1 as a poultry waste signature and principal component 2, step number 10, is the wastewater treatment plant signature.

Q. Let me call your attention, now, Dr. Olsen, to Exhibit 461. Would you identify that for the record, please?

A. This is an exhibit that I prepared based on the results of the PCA analysis.

Q. And what does it show?

A. Well, first of all, the green is just the outline of the

Illinois River Watershed. And then I put -- this signifies all the locations where we had samples that met those criteria that I had enough parameters to create PCA scores at these locations.

Q. Okay. And what are the significance of the green and red dots?

A. The red dots show all those locations that showed a poultry waste impact or signature. And the green dots show all those locations that did not have a poultry impact or signature.

Q. I notice that there's about six dots that are outside of the watershed, what are those?

A. Those are our unimpacted control or reference areas that were outside the basin.

Q. Okay. What did you conclude after you performed this spatial analysis of poultry waste signature on Exhibit 461?

A. Well, number one, just by looking at it, you can see that there's a lot more red dots than green dots. And number two, that those red dots are pervasive throughout the basin, clear from the top clear to Tenkiller.

Q. Are there some analysis done in Tenkiller water?

A. Yes, there are.

Q. And they also show the poultry waste in Lake Tenkiller?

A. Yes, yes, they do.

Q. And what does that lead you to conclude, if anything?

A. Again, the chemicals have been in the bacteria. This waste signature, this unique combination of chemicals has been transported completely through the basin from the source to Lake Tenkiller.

Q. Let me ask you to look at Exhibit 466 now, sir, and identify that for the record.

A. I should restate that a little bit. It isn't all those chemicals are transported. It's that the chemicals that are combined give you a score to indicate that waste -- poultry waste is also in Tenkiller.

Q. Did that include bacteria in your analysis?

A. Yes, there were some bacteria that were included in that principal component 1.

Q. Were they the indicator bacteria?

A. Yes, they were.

Q. Okay. Now, let's look at State's Exhibit 466. Would you identify that for the record, please?

A. This is just a summary of Exhibit 461 that I prepared, just giving the various percentages of poultry waste impact in each of the types of samples or each of those pathway components that we sampled.

Q. Okay. And in what percentage of edge of field samples did you find the poultry waste signature?

A. We found it in 100 percent of the edge of field samples.

Q. Just go down, please, and just identify for the Court the

percentages found in the different environmental components.
A. We found the poultry waste contamination in 60 percent of all the groundwater samples and 73 percent of all the surface water samples. And looking at all those water samples together, that would be 73 percent total.
Q. Now, Dr. Olsen, have you also examined the surface water samples that contain bacteria in excess of the primary body contact recreation standards?
A. Yes, I have.
Q. Have you looked at that in relationship to the poultry waste signature you've identified?
A. Yes, I have.
Q. What did you find?
A. I found in those samples which had exceedances of the state standards and for which I had enough analysis that I could create a PCA score, that 84 percent of those samples that have exceedances had poultry waste.
Q. So the exceedances that we showed on the board or the map, excuse me, 84 percent of the surface water samples had the poultry waste signature?
A. Just those samples that I had that extensive list of chemical contaminants that I could create a score, 84 percent of those samples had poultry waste in them.
Q. Okay. And what does this mean in practical terms?
A. It means that practically whenever we had an exceedance,

the vast majority of those had poultry waste.
Q. And did you do a similar analysis for groundwater?
A. Yes, I did.
Q. And what did you find?
A. Again, for those samples of groundwaters that had bacteria and for which I had enough parameters to do the PCA evaluation, 67 percent of those samples had poultry waste in them.
Q. Again, what does that mean in plain terms?
A. It means that over two-thirds of those samples that had exceedances that I could evaluate had poultry waste contamination.
Q. Now, very briefly, Dr. Olsen, I want to finally look at Plaintiffs' Exhibit 454. And while you're getting that, I want to ask you a question. After you had your deposition taken in this case, did you discover that your statistical analysis was run with rejected data?
A. Yes, I just was doing some checking and of the actual results and looking at individual scores and individual contaminants, I noticed that there was some rejected data in the evaluations.
Q. How did that happen?
A. It wasn't in the data. It was in the database flagged right that we used, but we forgot to carry over those flags when we created subsets of data to do the PCA analysis on.
Q. So there was a problem with the query of the computer?

A. Yes.
Q. And how much of the data -- did you then run the evaluation with the proper data?
A. Yes, we did.
Q. How much of the data did you end up rejecting because it was rejected data?
A. There were, out of 14,700 pieces of data, that is actual analysis of contaminants that was in our PCA runs, we -- there were 677 rejected pieces of data out of the 14,700.
Q. How did that affect the number of samples you evaluated?
A. We had to drop 17 samples from the analysis. And those were all samples that were collected very early in the program and associated with some bad bacteria data that we had very early in the program. Essentially, we had to drop them because we no longer had the 20 out of the 25 parameters we needed.
Q. Was that the FoodProtech data was rejected?
A. That's right.
Q. And how many then total samples of what universe were dropped?
A. Again, we dropped 17. The analysis that I was just talking about and presented was based on 621 individual samples. We now have, without the rejected -- not including the rejected data, we have 604 samples.
Q. Okay. And did this rejection of the rejected data cause your opinions to change in any material way?

A. No, not at all.
Q. Would you briefly just explain what Exhibit 454 is?
A. 454 just shows the -- the runs with and without the rejected data. On the left is what we call the A, that's principal component 1, that's the chicken poultry signature that I've been testifying to. And then on the right is the same analysis done without the rejected data. You can see they're almost identical, all the high factors are similar --

MR. GEORGE: Your Honor.

THE COURT: Just one second, Doctor.

MR. GEORGE: I apologize for interrupting. I'm trying to recall where we drew the line but I believe that the Court's ruling was that the witness could certainly acknowledge that an error was made and state that it did not change his opinion, but now he's giving the substance of the new analysis in testimony.

THE COURT: Yeah, I expected some of this to come up in redirect and recross. So I think that the objection is well taken at this point in time. I understand where we are and the Doctor's testimony was consistent with what was told to the Court earlier about the rejected data. So Mr. Page.

MR. PAGE: I'll pass the witness, Your Honor.

THE COURT: Very well. Mr. George.

MR. GEORGE: Your Honor, I'm afraid if I get started, you won't want me to stop. It's going to be so exciting.

Q. Dr. Olsen, good evening. You and I have met before on one occasion, have we not?
A. Yes.
Q. It's a pleasure to see you again. Sir, you're employed by Camp, Dresser & McKee; is that correct?
A. That's correct.
Q. How much has Camp, Dresser & McKee been paid for its work in this case, sir?
A. I do not know the exact number. I'm not involved in the financial aspects of the project but it probably is on the order of 5 to 6 million.
Q. Do you recall in your deposition taken approximately three weeks ago that at that time you estimated it was six million?
A. Well, okay, six.
Q. And sir, you continue to work, I presume, since then along with other folks at Camp Dresser; correct?
A. Yes.
Q. Who has paid the $6 million, is it the attorney general's office?
A. No.
Q. Who?
A. It's the law firm of Motley Rice.
Q. Sir, your role in this case, as I understand it, I don't want to oversimplify it, so you tell me if you disagree, has been to investigate environmental conditions in the Illinois

River Watershed and the cause of those conditions. Would you agree with that?

A. Yes.

Q. And in addition to conducting that investigation, you have served as the technical director for the scientific team, if you will, of experts working on behalf of the attorney general's office; correct?

A. Yes, I helped coordinate all the other experts.

Q. Sir, do you agree that to be scientifically valid, a scientist must go into his or her work with an open mind?

A. Yes.

Q. It would be contrary, would it not, to the scientific principles of the scientific method to form your conclusion first and then to try to selectively identify data to support that conclusion; correct?

A. Certainly.

Q. Sir, did you go into this project with an open mind with respect to the sources of potential contamination in the Illinois River Watershed?

A. Yes, I certainly did.

Q. Put Defendants' Exhibit 275 on the screen, please. This has already been introduced. Do you recognize this memo, it's been discussed? Do you recall it?

A. No, I'd have to look at it.

Q. Can you identify the fax cover sheet?

coliform bacteria in 2008 or 2009 if the Court enters the injunction your client requests?

A. Again, I've not been asked to answer that question.

Q. Sir, the sophisticated principal component analysis that you've discussed with the Court in your direct testimony will not tell us the relative contribution of sources in the watershed, will it?

A. Not as it is currently constructed. It will tell you the relative magnitude of those principal components.

Q. Well, sir, through your work in this case, you do not have a sufficient basis to offer a quantitative opinion, do you, sir, on the improvement of bacteria levels in the Illinois River Watershed if one source or potential source, poultry litter, is enjoined?

A. I have an opinion that it will vastly improve, but I haven't quantified that.

Q. You haven't quantified it, have you, sir?

A. That's right.

Q. You've done no statistical analysis to allow you to provide more detail on vastly improved; correct?

A. That's right.

Q. It's just your gut feeling; right?

A. No, sir, those principal components are very well defined. Those signatures are very well defined. The vast majority of impact is associated with principal component 1. So if you

eliminate that, it's going to vastly improve.
Q. Sir, the principal component analysis that we've been discussing is a statistical tool, would you agree?
A. The first part of it was, steps 1 through 7 that I identified is a statistical tool.
Q. The principal component analysis simply allows you to look at relationships within a dataset regardless of what the dataset is; correct?
A. No, it goes further than that. It creates a score that I've talked about in step number 7 that tells you how that's related to various principal components and the magnitude of that impact. It also tells you how prevalent that score is throughout the basin. So it just doesn't tell you about relationships.
Q. Sir, would you agree that the principal component analysis can only compare data that you have selected and put into the database?
A. Data in, data out. I mean, you only analyze what you put in. I mean, that's a given fact.
Q. How many samples did you include in your principal component analysis run, your most recent one?
A. The ones that met my criteria were 620. That's essentially the total set of samples that we analyzed for the extended list of parameters.
Q. So, sir, out of the 2,661 samples that you testified at

length that you collected, you've only analyzed through your PCA analysis 600; correct?

A. 621, and let me tell you why.

Q. I think you've already testified to why with regard to the number of parameters.

A. No, I haven't. You know, most of those samples were not designed --

Q. Sir, you'll -- I'm sorry.

A. Could I explain?

THE COURT: Well, I'm sure Mr. Page will ask that.

MR. GEORGE: I'm sure. I've got limited time, sir.

THE COURT: I'm interested in the answer as well. So go ahead.

Q. (By Mr. George) Sir, the data that you chose not to include in your principal component analysis would include samples such as fecal matter collected from cattle; correct?

A. No, they were in there.

Q. You took samples from --

A. Excuse me, I misspoke. We had samples that were substantially impacted by cattle and that's how I could tell that those were different. I did not specifically take samples of fecal matter from cattle, however we ended up with springs and edge of field samples that had cattle in them.

Q. Let's break it down, if we can, sir.

A. Sure.

on the right-hand side, a solid poultry litter and solid cattle waste?

A. That's right. The theory is that if it's in the solid waste, some of it is going to leach out into the environment and it should create a similar pattern with the surface water principal component score. That isn't the case in all cases. For instance, calcium leaches very different from cow manure than it does from poultry litter. Copper leaches very different because it's mobilized with the organic carbon in the litter. So you have to consider leachability when you do this comparison too. But generally you can see that everything that's high is in the solid material is also high in that surface water principal component 1 which is the poultry signature.

Q. Let's go back to sampling if we can, sir. The State's consultants through CDM collected cattle manure samples in this watershed; correct?

A. They didn't specifically mean to collect cattle water -- cattle samples but there were springs that had cattle samples -- cattle waste in it. And there were some edge of field samples that had cattle waste in it.

Q. Let me stop you, I think maybe we're miscommunicating. Is it not true that in connection with the work that was done by Dr. Harwood, that CDM representatives collected actual samples of cattle manure from the watershed?

A. Yes, that was -- I'm glad you clarified that. That was only done for the quantitative PCR analysis.

Q. Okay. And you took those cattle samples of waste and you took them to a lab and had them analyzed in terms of their chemical composition; correct?

A. No.

Q. You did not?

A. No, I did not.

Q. You had that material, you could have sent it to a lab and had it analyzed; correct?

A. Yes, and we plan to collect cattle samples now and do that exact same thing.

Q. Well, why haven't you done it already?

A. Well, you can see the -- this is the way a principal component works. If the waste is there and it's significant, for instance, the cattle waste or the wastewater treatment plant. By the sampling we did, you're going to see that waste signature if it's significant. We, of course, saw the wastewater treatment plant signature. We didn't see the cattle signature. My conclusion is that the cattle signature is not significant. I went to specific samples that I knew had cattle waste in it and I could see a distinct difference, particularly with the poultry waste. So I knew what I was looking for and it just wasn't a dominant signature across the basin. I found it in, like, significantly in one spring sample and I found it

not significant in three other spring samples. I found it significant in four edge of field samples and not so significant in five others. So it's just not a dominant signature across the basin. If it would have been, I would have found it.

Q. Sir, okay, I think you're answering a question other than the one I asked, sir. So if at all possible, I'd ask that you keep your responses to my questions. Dr. Olsen, your comment that you validated your belief that you can exclude this cattle signature by going back to specific locations is limited to the information you have about which edge of field samples and which fields are affected by cattle; correct?

A. No.

Q. Sir, you don't know, with respect to all the places that you collected edge of field samples in this watershed that you believe are poultry litter signature samples, the extent to which those areas are impacted by cattle, do you?

A. I know exactly what waters and what edge of fields are impacted by cattle and which are not because it has a completely different chemical composition and I can tell the difference.

Q. Let me move away from how you are interpreting the results and let's talk about what you actually know about the field, okay, sir? With respect to the edge of field locations where you have detected what you believe is a poultry litter sample,

ROGER LEE OLSEN

Called as a witness on behalf of the plaintiffs, having been previously sworn, testified as follows:

FURTHER CROSS-EXAMINATION

BY MR. GEORGE:

Q. Good morning, Dr. Olsen.

A. Good morning.

Q. Sir, when we last left, we were talking about your principal component analysis. Do you recall that?

A. Yes, sir.

Q. Sir, if I understand correctly, the principal component analysis is performed through some statistical software; is that right?

A. Yes, sir.

Q. What is the name of that software?

A. We used a combination of Excel and Sysstat.

Q. And at a basic level, that's about the level at which I understand, so you can straighten me out if I'm wrong, sir, the principal component software takes the data that you decide to give it; correct?

A. Yes.

Q. Okay. And it looks for relationships within that data between the list of parameters or constituents that you select; correct?

A. And all the samples, yes.

Q. What are those variables?
A. Those are the contaminants that were analyzed for.
Q. And across the top there is a listing of factors. Do you see that?
A. Yes.
Q. And it appears to me it goes factor 1 through factor 5; is that right?
A. Yes.
Q. What are those factors?
A. Those are the principal components that we've been talking about, principal component 1 and principal component 2 that would correspond to factor 1 and factor 2 in this run.
Q. Okay. Now, beneath each factor is a long number that begins with a decimal; correct?
A. That's correct.
Q. And those numbers are loading values; is that correct?
A. These particular ones here are correlation coefficients. If you -- under the no rotation, they're actually directly proportional to the coefficients or the loadings that we actually use. So it's a number similar to this and the order would be the same but these aren't the numbers that are actually used in the final analysis of the component score.
Q. Now, Dr. Olsen, with respect to the factors, factor 1 through 5, the computer does not identify those as poultry; correct?

A. No, that's right.
Q. This is not a situation where you feed a bunch of chemical data into a computer and it prints out the word poultry as a source; correct?
A. That's correct.
Q. Now, let's go back a little further in the documents to the percent variance page. Can you find, Dr. Olsen, in the materials I've handed you, the page that shows the percent variance? You're familiar with that term?
A. Yes.
Q. And we'll pull it up on the screen so that Your Honor can see it. Sir, now, the computer generates a value for each factor amongst this data that was analyzed in terms of percent variance explained; correct?
A. Yes.
Q. I think you told me in your deposition that this is what you look at in making a determination about chemical signature; correct?
A. I said that was one of the factors. You remember I said the overriding factors was to try to keep as many as parameters possible and still explain a maximum percent of the variance.
Q. Right, but percent variance, the higher the percentage, the more comfortable you are with the idea that the factor described explains something in the data; correct?
A. As long as you have enough parameters in there. So

Q. You decided that principal component 1 represents a single non-point source of contamination from poultry litter rather than a combination of different sources; correct?

A. That's correct.

Q. Sir, have you subjected those conclusions regarding your interpretation of these results as indicating a poultry signature to the formal peer review process to allow scientists other than those retained by the Motley Rice Law Firm who are experienced in interpreting PCA results to evaluate the soundness of your methods and conclusions?

A. You mean like to a journal or something like that?

Q. Yes, sir.

A. No, we haven't at this time. We plan to do that.

Q. Dr. Olsen, out of all the scientists in the world who have studied water quality in areas where poultry production occurs, you're the only one, aren't you, sir, who holds the opinion that the list of parameters that we saw in your direct examination constitute a poultry signature?

A. Well, that poultry signature is specific to this basin and I'm the only one besides other scientists in our company and one outside reviewer that's looked at this. So no other people outside the group or our scientific reviewer has seen this, so no one else has made that conclusion.

Q. You recall being asked these same questions in your deposition, sir?

A. Yes.
Q. Okay. Let's look at what you said in your deposition.
Cassie, I want to play two clips back to back, if I can, sorry. Page 120, lines 13 through 18 and page 121, lines 3 through 122, line 2?
(An excerpt of the videotaped deposition of Roger Olsen was played.)
Q. "Are you aware of a single other scientist in the world who claims to have identified this list of 25 constituents and the coefficients that you've developed and called that a signature for chicken litter influencing water?
A. "I'm not aware of any, no."
MR. GEORGE: Play the next one too, please.
(An excerpt of the videotaped deposition of Roger Olsen was played.)
Q. "Dr. Olsen, how long have scientists and governmental bodies been studying the potential impact of poultry litter on water quality in the United States?
"MR. PAGE: Object to the form.
A. "I don't know the exact data. I'd have to go back and look at some of the literature sources.
Q. "Do You agree that work as been ongoing for at least decades?
"MR. PAGE: Object to the form.
A. "I think it just most recently -- I don't know if it's

been going on for decades. I can't determine that. It's certainly gotten much more scrutiny in the last few years.

Q. "And during all the length of that study by scientists from other firms and government regulators, no one other than yourself has identified this 25 list of parameters in certain concentrations as a chemical signature for poultry litter; is that true?

"MR. PAGE: Object to the form.

A. "That's my unique work to develop that signature. It's just like no one has ever developed a qPCR for chicken litter. We did it and we did get a signature too."

Q. (By Mr. George) Dr. Olsen you were here during the examination of Secretary of the Environment Tolbert?

A. No, I was not.

Q. You were not here for that, okay. Were you here for opening statements?

A. No.

Q. You are aware, are you not, sir, that the Illinois River Watershed and in particular water quality in the Illinois River Watershed has been the subject of numerous reports from universities and government agencies for at least the last 20 years?

A. Yes, I'm aware of some of those studies.

Q. Sir, and have you seen in any of those studies a suggestion by any of the authors that they believe that the

Q. Sir, is total organic carbon unique to poultry litter?
A. No, it isn't.
Q. You find total organic carbon everywhere in the environment, correct?
A. In varying concentrations you find it, from very small to very large --
Q. Would you find --
A. It happens in chicken waste it's a huge amount.
Q. Sorry, didn't mean to cut you off. Do you find total organic carbon in soils?
A. Yes, you do.
Q. Copper, you find copper in soils; correct?
A. Yes, you do but it's, again, the amount. We find so much more of it in the wastes than we do the soils.
Q. Sir, with respect to this list that is in front of you, are any of the 25 components that you used in your analysis unique to poultry litter?
A. No.
Q. Sir, are every one of these components found in other sources that are known to exist in the basin in varying concentrations?
A. Most of those would be -- well, again, you have to determine detection limits. Like for cow, essentially there's -- or a wastewater treatment plant, there's essentially no arsenic and no copper. So there's some there, but you just

can't detect it. And then compared to, of course, poultry waste, those are very, very large numbers. So when you say if it's present or not, you really have to talk about an analytical detection limit. So some of these would not be present in other wastes.

Q. Which ones would you not find in another waste in this watershed?

A. Well, there's always some, but many of the analyses I've seen from wastewater treatment plants for like arsenic are below detection limit. Same for either zinc or copper.

Q. Let me stop you because I think maybe you are answering a different question. Are there any of these that you would not find detectable in at least one source other than poultry litter that's present in this watershed?

A. Well, by source you're meaning everything?

Q. Everything.

A. I'd have to review but, again, some of the trace metals, you would find those in soils, of course, but particular waste, you may not find some of these trace metals. I'd have to review all those other sources which I haven't reviewed all those other sources. I've reviewed wastewater treatment and cattle.

Q. Dr. Olsen, soils are a source of contaminants in the water in the Illinois River Watershed; correct?

A. They run off with it, with the -- when you have runoff,

the soils are incorporated. But it turns out that those trace elements that are in the soils are not soluble, whereas in poultry waste they're very soluble and that's why we find them.

Q. Dr. Olsen, one of your parameters that you have identified as part of your unique signature for poultry is calcium; correct?

A. Yes.

Q. Sir, were you here when Dr. Fisher testified?

A. For part of that.

Q. Did you hear Dr. Fisher describing the limestone that underlies much of the Illinois River Watershed?

A. Yes.

Q. And what is limestone composed of, sir?

A. Calcium carbonate.

Q. If you look at your list of components, there are three different types of phosphorus, are there not, in your signature?

A. One point on the calcium, it's negatively related to the signature.

Q. Sir, if you could stay with my questions, your counsel will follow up with you. And I've only got limited time, so I don't mean to be rude at all but I do want to get through what I can. With respect to phosphorus, Dr. Olsen, there are three different types of phosphorus in your signature; correct?

A. That's correct.

Q. One of them, total phosphorus, is a combination of two of the others; correct?
A. Not a direct combination of the others.
Q. Well, phosphorus SRP and dissolved phosphorus would be two of the things that go together to comprise total phosphorus; correct?
A. What was that again, SRP is soluble reactive.
Q. Dissolved phosphorus.
A. Those two don't add up to give you total there. They're different.
Q. Are they included in total phosphorus?
A. The total up here, they're included in that, yes, sir, but they're different.
Q. You included nitrogen in your chemical signature for poultry. Nitrogen is found naturally in the soils; correct?
A. There's several forms of nitrogen I've included. And it depends on what form you are talking about, but it's found in soils.
Q. I'm talking about the form in your signature.
A. Well, the one that's found in the signature that's most prevalent is total Kjeldahl nitrogen, that's both organic nitrogen plus ammonia. That's a specific type of nitrogen. And again, that relates to the signature of what type of nitrogen you find in the various components.
Q. That type of nitrogen is found naturally in the soils,

correct?
A. In some soils, yes.
Q. In the soils in the Illinois River Watershed, you know that to be true, don't you?
A. There is some organic nitrogen in some soils.
Q. Sir, potassium is found naturally in the soils in the Illinois River Watershed; correct?
A. That's correct.
Q. Now, sir, you collected litter samples and you had them analyzed for a lot of things beyond the 25 that are on your list; correct?
A. That's correct.
Q. You know, do you not, sir, that nickel is found in poultry litter?
A. There's some concentrations of nickel in poultry litter. I'd have to look up those exact --
Q. Isn't it, in fact, true, Dr. Olsen, that you detected nickel more commonly in the environment than you did many of the things you've included in your signature?
A. I don't think that's true. I'd have to go back and look at the data.
Q. If nickel is in poultry litter, why is it not in your poultry litter signature?
A. Again, this is -- this signature is based on actually what leaches from the field and what gets into the environment. If

that it will give a different signature, we would see it in the basin. So the real proof of identifying sources is what signatures you see in the actual samples from the basin.

Q. Dr. Olsen, when you say we see in the basin, you mean you, I see in the basin; correct?

A. Yes, with input from the other experts, yes.

Q. Dr. Olsen, you know, do you not, that cattle manure contains E. coli, Enterococcus and total coliforms?

A. Yes, I'm aware of that and I haven't made any statement that it didn't.

Q. And after $6 million worth of work in this case, you couldn't find a single piece of literature that reported the concentrations of E. coli, Enterococcus and total coliforms in cattle manure?

A. Again, I didn't do an extensive list. I'd be glad to get any literature and add that to this list, if we can.

Q. Well, did you consult with Dr. Teaf to see if he had any literature on the presence of bacteria in cattle?

A. No, I didn't.

Q. Were you aware that Dr. Teaf had performed computations as to the number of fecal coliform bacteria in cattle?

A. I was aware that he was doing some computations on that.

Q. Let's go down to phosphorus, soluble reactive phosphorus and soluble phosphorus. You know, do you not, sir, that cattle manure contains soluble phosphorus?

A. Yes, it does, but I couldn't find a value for that in the literature.
Q. After all the money that you've been paid and all the time that you've spent on this case, you couldn't find literature that would report a value for soluble phosphorus for cattle manure?
A. Yes, I didn't do an extensive list or an exhaustive list of trying to find all these parameters.
Q. Dr. Olsen, who did your search for you?
A. I had our librarian do the search for waste, cattle waste analysis and she did a computer search for that.
Q. Did you explain to that librarian that you were going to present this information to a federal court and that you needed it to be as complete as possible?
A. She did -- I told her what to search for and she searched all the journal articles available and all the databases she could find to do this.
Q. Dr. Olsen, you also collected samples of human waste from septic tanks as part of your work in this case; correct?
A. I did not collect those. Those were collected for the PCR analysis.
Q. Did somebody working with your company, Camp Dresser & McKee, collect samples of human waste from septic tanks?
A. Actually those were collected by staff from Lithochimeia.
Q. But you're the technical director, you knew that work was

whether you agree with them. Let's start, if we can, on page 5 -- it's listed 510, the summary section.

MR. GEORGE: And by the way, for the record, Your Honor, what I put in front of the witness and I provided a copy, of course, to counsel for plaintiffs, is the cover page, the copyright page, and then this is actually a multi-chapter treatise. I've included the chapter on principal component analysis which is Chapter 12.

THE COURT: Yes, sir.

Q. (By Mr. George) Do you see at the bottom of page 510 in the summary section on principal component analysis, sir, the very last paragraph. There should be some highlighted language in your copy, is there?

A. There's two highlights, which are you referring to?

Q. Let's talk about the last one first. Let me read it and I want to ask you if you agree with this. "PCA, the earliest of the procedures discussed in this chapter, works best in simple cases where there are few sources contributing to the system and there's limited mixing between sources. If an initial PCA indicates the presence of mixtures, it is usually best to move to a data analysis method capable of resolving the nature of that mixture." Do you see that?

A. No, I don't see where you are reading at all, sir.

Q. Sorry, it's on the screen, it be highlighted. Let me look at your copy to make sure you have one that's highlighted.

Yours is not highlighted for some reason.

A. I didn't follow you at all there.

Q. Let me do it again, I want you to follow me. I want to read it and it should be on your screen highlighted, Dr. Olsen. It might be easier to look at your screen. "PCA, the earliest of the procedures discussed, works best in simple cases where there are few sources contributing to the system and there is limited mixing between sources. If an initial PCA indicates the presence of mixtures, it is usually best to move to a data analysis method capable of resolving the nature of that mixture." Do you see that?

A. Yes, I do.

Q. Do you agree with that statement?

A. Let me read that again. Let's see. Works best for simple cases where there are few sources contributing to the system. Again, we only have a few sources here contributing to the system. I wouldn't say it's a simple case. I think PCA works for these very complex cases. And there is limited mixing between the sources. Actually, we didn't find a lot of mixing between the sources. It was very clear when we had mixing and when we didn't and we could identify that mixing. And overall, there was limited mixing of the sources in our analysis and that's very clear when we did the PCA scores on everything and compared scores 1 and 2.

Q. Dr. Olsen, so if I understand what you've just said, you

believe that the Illinois River Watershed is a system which only receives input of the things on your list of parameters from a few sources, two?

A. No, there's three major sources out there and we were able to identify two. And we were able to identify when those two sources mixed together and we see that out there frequently. There is a third source, cattle source. We were able to identify specific samples of where that was and those few specific samples were mixed with the other samples. So I would say there was limited mixing overall and we could identify where that was.

Q. Dr. Olsen, if you could turn back a few pages to page 464 in this treatise. There should be a highlighted paragraph which I'm going -- we can read it all, but I'm interested in some particular things. You'll see it on your screen, Dr. Olsen, but I'll certainly give you time to find it in your paper, too. Do you have page 464 in front of you?

A. Yes, I do.

Q. Do you see the first paragraph?

A. Yes.

Q. I'm going to read some portions of that paragraph and then ask you whether you agree, sir.

"Regardless of the data analysis strategy chosen, another important consideration is the presence of bad or questionable data. Common problems with environmental chemical

data include the following: Chemical analysis performed by different laboratories or by different methods which may introduce a systemic bias, the presence of data at concentrations at or below method detection limits, the presence of coelution, the ever-present problem of error in data entry, data transcription or peak integration."

And Then dropping down, sir, to the first two sentences of the second paragraph. "Unfortunately such errors rarely manifest themselves as random noise. More often, they contribute strong systemic variability. If unrecognized, the result may be a derivation of 'fingerprints,' which have little to do with true sources."

Do you see that language, sir?

A. Yes, I do.

Q. Do you agree with that as a description of the problems associated with bad or highly variable data used in a PCA analysis?

A. With bad data, not with -- with bad data, not with high variability data. I mean, you're looking for data that has a lot of variability.

Q. Poor term on my part. What about biased data?

A. Yes, and all these four things that are listed here, we checked very carefully in our analysis when we did them.

Q. Dr. Olsen, there were multiple laboratories who ran analysis that the results of which were used in your PCA;

A. Yes, I did for the most recent runs.
Q. Sir, how many PCA runs in support of your chemical signature analysis did you perform with the rejected FoodProtech data still in there?
A. There were a substantial number until I discovered that some of that rejected data was still there.
Q. Let's quantify. You're up to PCA run 9 today; correct?
A. I don't have any recollection what you mean by PCA run 9. There's been lots of runs and we didn't number them like that.
Q. Do you quarrel with the notion that you've run your PCA at least nine times?
A. We've run it -- no, we've run it hundreds of times, sir.
Q. So you ran your PCA database analysis hundreds of times?
A. Yes.
Q. With the FoodProtech rejected data?
A. No, I didn't say that. I said overall we've run it that many times.
Q. Well, sir, you just pulled out the FoodProtech data about two weeks ago; correct?
A. Yes, and we've done substantial runs since that time to verify that everything was still valid.
Q. Have you run it hundreds of times since then?
A. No, I didn't testify to that, sir.
Q. And every time that you ran that PCA analysis with the rejected FoodProtech data in it, you saw the chemical signature

demonstrative exhibit. It shows your list of parameters?
A. Yes.
Q. Sir, the only bacteria in your signature for poultry litter is E. coli, fecal coliforms, Enterococcus and total coliforms; correct?
A. That's correct.
Q. You know, do you not, sir, that all four types of those bacteria are found in cattle manure?
A. I don't know that for sure but I suppose they are, yes.
Q. You know, do you not, sir, that all four of those types of bacteria are found in human waste deposited in septic tanks?
A. Probably so.
Q. You know, do you not, sir, that all four of those bacteria are included in the feces of wildlife that live in the Illinois River Watershed?
A. I do not know that for sure.
Q. You don't know that?
A. No. I'm not a bacteria expert.
Q. All right. Dr. Olsen, does your signature allow you to identify -- strike that. Let me approach it this way. Dr. Olsen, your signature does not allow you to identify any farm contracting with Tyson Foods, George's or any other defendant represented in this courtroom as a source of any area of water contamination in the Illinois River, does it?
A. You mean does it allow me to identify a specific farm?

Q. A specific farm under contract with one of the defendants.
A. No, I've not been asked to do that.
Q. Does it allow you to identify a specific defendant?
A. No, I've not been asked to do that.
Q. Going to Demonstrative Exhibit 461, State's Demonstrative Exhibit 461. Dr. Olsen, you prepared this map; correct?
A. That's correct.
Q. And I didn't quite follow this, so I want to discuss it with you. In your direct examination, there was some attention drawn to the green dots outside of the Illinois River Watershed.
A. Yes, sir.
Q. Do you recall that?
A. Yes, sir.
Q. And I think you described those as control areas; is that right?
A. There's three green dots. There's one right above the basin, that's Spring Creek. And there's two below the basin, far below the basin, not that far, kind of on the county line there that are Little Lee Creek. And there's a green dot that can't be shown here because it's Dry Creek, it's in the Buffalo Creek area. Those are the reference areas for surface waters. Those other three happen to be springs that were collected. I didn't really associate those were reference areas. Again, they were just trying to collect all the springs. So those are